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ABSTRACT

Research on logical competence in adulthood was framed by the general competence-moderator-performance model of life span cognitive development constructed by Overton and his colleagues. This approach was able to distinguish between logical knowledge necessary for task solution and informational processes that may facilitate or inhibit the accessibility of available logical knowledge. Wason's selection task provided a particularly appropriate domain for exploring issues concerning levels of logical reasoning competence and the effect of semantic content, as the latter is mediated through informational processes. The study also investigated the role of semantic content in the solution of deductive reasoning problems. Two experiments were conducted. In the first, college-age and elderly subjects were presented five variations of Wason's selection task--three containing content familiar to the younger subjects and two containing the standard abstract content. In the second experiment, three of the five variations of Wason's selection task contained content relevant to the older subjects and the other two were the same abstract content variations used in the first experiment. The findings indicated that older adults perform as well as young adults despite the materials being relevant to the younger group. Study 1 demonstrated the retention of deductive reasoning ability across the adult years, as well as the role of semantic content as a moderator. Study 2 showed only the effect of semantic concept, but did not support a hypothesis of late adult reasoning competence. The study concludes that when content is meaningful and youth oriented, older adults demonstrate intact logical reasoning abilities. However, when meaningful, elderly oriented content is used, the older subjects perform quite poorly. It is possible that old-relevant content may raise strong emotional involvement in the elderly resulting in poor performance or that age-related content may produce exceptions that lead the elderly not to respond formally to the stated rule. A two-page list of references and the five variations of Wason's selection task used are appended. (YLB)

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DEDUCTIVE REASONING IN YOUNG AND ELDERLY ADULTS

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Deductive reasoning in young and elderly adults

Do older adults retain the capacity to make logical deductions? This question has been relatively neglected in past research. The few studies that have focused directly on the ability to reason deductively in late adult years report conflicting findings (Cohen, 1981; Golding, 1981; Overton, Franco, & O'Brien, 1984). Overton, Franco, and O'Brien (1984) gave older subjects contradiction training which involved giving examples of correct reasoning to discourage invalid inferences for deductive reasoning problems. These researchers found that with the contradiction training, the older subjects exhibited logical reasoning skills. Golding (1981) reported that older adults actually perform better than college subjects when given task contents which are appropriate to the older subjects. Cohen (1981) examined the use of various reasoning argument forms and concluded that there is a deficit in conditional reasoning ability in the adult years.

The primary goal of the present research is to gather further information on the question of logical competence in adulthood. This research is framed by the general competence-moderator-performance model of life span cognitive development constructed by Overton and his colleagues (Overton, 1984; Overton & Newman, 1982). This model, when applied to the adult years, is similar in approach to the dual process conception of adult intelligence suggested by Baltes, Dittman-Kohli, and Dixon (1984) in that it deals with the interplay between underlying cognitive

structures (competence) and the application of competence (performance) as mediated by various moderator variables. With respect to the present research, the main feature of this approach is that it distinguishes between logical knowledge necessary for task solution and informational processes that may facilitate or inhibit the accessibility of available logical knowledge. It is suggested that across adulthood, the competence to reason deductively is maintained, and that poor performance is a function of moderator variables, specifically the form and content of logical propositions.

Wason's selection task provides a particularly appropriate domain for exploring issues concerning levels of logical reasoning competence and the effect of semantic content, as the latter is mediated through informational processes. In its standard abstract form this task presents subjects with an array of four cards showing, for example, the letter E, the letter K, the number 4 and the number 7. THIS TASK CAN BE FOUND IN YOUR HANDOUT. In addition, subjects are presented with a conditional rule, "If there is a vowel on one side of the card, then there is an even number on the other side." Subjects are to select those cards and only those cards which would have to be turned over to decide with certainty whether the rule is true or false.

The selection task was recently employed by Overton, Ward, Noveck, Black and O'Brien (1986) in a series of studies investigating the development of deductive logical competence. These studies demonstrated, developmentally, that once the competence to solve conditional reasoning problems is acquired,

this competence is significantly affected by task content. Following Golding's findings with respect to older adults, it would be expected that performance would be better on task content that is more familiar to older adults than on tasks with less relevant content. Therefore, a second aim of this study is to investigate the role of semantic content in the solution of deductive reasoning problems.

Two experiments were conducted to investigate these issues. In the first experiment, college age and elderly subjects were presented 5 Wason selection tasks. Three of these contained content familiar to the younger subjects and the remaining 2 tasks contained the standard abstract content. In the second experiment again 5 Wason selection tasks were administered, 3 contained content relevant to the older subjects, and, the same 2 abstract content tasks. THESE TASKS ARE PRESENTED IN HANDOUT 2.

In experiment 1 the subjects were 20 college undergraduates with a mean age 19 years, 8 months, and 20 senior citizens, with a mean age of 69 years, 3 months. Five variations of Wason's (1966) selection task were used. Three problems employed familiar young-relevant content. These were, as shown on HANDOUT 2, the Drinking Age Problem (Cox & Griggs, 1982); Motor Vehicle Problem; and the School Problem. The remaining two problems employed abstract content as listed on HANDOUT 2. These were the Vowel and Abstract Problems.

For each problem there were four response alternatives. THIS CAN BE FOUND ON HANDOUT 1. These response alternatives

correspond to the affirmation and denial of p and q. The correct solution to each problem consists of the selection of only those two alternatives that could falsify the rule, that is, the p alternative, yielding a p and possible -q, and the -q alternative, yielding a -q and possible p.

Each problems was presented on a separate page of a booklet. Using the Drinking Age Problem as an example, the format of each page was as follows: At the top of the page the four response alternatives, Drinking Beer (p), 22 years of age (q), Drinking Coke (-p), and 16 years of age (-q), were presented in rectangular boxes as found in handout 1. Subjects were instructed that each card has information relevant to a person sitting at a table. For this problem, the information on one side of a card is a person's age and on the other side of the card is what the person is drinking. Each problem has a conditional rule, here the rule stated: IF A PERSON IS DRINKING BEER, THEN THE PERSON MUST BE OVER 21. The subject's task is to decide with certainty which card or cards that you would definitely need to turn over to decide whether or not the rule is being broken. A totally correct falsification solution requires the selection of the p card and the -q card, and not the selection of the -p or q cards.

Three types of scoring were employed to assess logical competence. First, a general solution score that gave partial credit for partial correct solution to each problem was determined. For each problem a subject received 1 point for each of the four response alternatives if p and -q were chosen and if -p and q were not chosen. A second scoring method consisted of the

specific combinations of response alternatives selected by subjects on each problem. In this case a p,-q selection pattern indicated a complete falsification solution. A final method of scoring was the determination of the consistency of falsification solutions for each subject.

We will first consider age effects. Using the general solution scores, an anova revealed **no main effect nor significant interactions for age.** The mean scores out of a possible 1.00 were .69 for the college-age group and .66 for the senior citizens. Although the content employed here was less familiar for the older subjects, their high level of performance strongly suggests that the older subjects still possess the necessary logical competence.

In order to assess age-related performance more closely, an examination was made of the complete falsification solutions at each age level. Considering all five problems (familiar and abstract) the complete falsification solution was given by college students 38% of the time and by the senior citizens 33%, neither of these are significantly different from chance responding, (chance = 31.25%). However, when only the three familiar problems are considered, college students gave complete falsification solutions 60% of the time and senior citizens 53% of the time. Both of these percentages are above chance responding (chance = 18.75%) and they do not significantly differ from each other. These findings indicate that the older adults perform as well as the young adults despite the materials being relevant to the younger group. Although they are in contradiction to Golding findings, these

results clearly support the view that adults do retain the competence to reason deductively.

Turning now to the question of the role of content, the main anova revealed a main effect of problem. Subsequent comparisons indicated better performance for the Drinking Age and Motor Vehicle Problems than for the School, Vowel and Abstract Problems. Performance on the School Problem was not significantly different than perfomance on the Vowel and Abstract Problems. Finally, there was no difference in performance on the two abstract content problems. There were no interactions of problem with any other factors.

The final facet of performance that we examined was a comparison of the consistency of complete falsification solution across familiar problems. Because of the anomalous nature of the familiar School Problem this problem was not considered and the consistency score for each subject was the complete falsification solution provided on each of the remaining two problems. Expressed as the percentage of the total number of subjects at each age level, these scores are 71% for the college students and 50% for the senior citizens. These percentages are not significantly different.

In experiment 2, 20 college undergraduates with a mean age 19 years, 4 months, and 20 senior citizens, with a mean age of 71 years, 3 months were subjects. None had participated in experiment 1. For this experiment the three familiar content tasks were taken from domains relevant to the older subjects. These problems were the Medication, I.D., and Pension problems and

can be found in HANDOUT 2. The remaining two problems were the same abstract content problems used in experiment 1.

Turning to the results, unlike experiment 1, an anova, using the general solution scores, did reveal a **main effect of age.** The mean scores out of a possible 1.00 were .67 for the college-age group and .57 for the senior citizens. This finding was quite surprizing to us and it also contradicts the results of Golding's work which indicated better performance when the content consists of age-relevant material.

As in experiment 1, an examination was made of the complete falsification solutions at each age level. Considering all five problems (familiar and abstract) the complete falsification solution was given by college students 23% of the time which is not significantly different from chance responding, (chance = 31.25%) and by the senior citizens 12%, which is significantly below chance responding, (chance = 31.25%). When only the three familiar problems are considered college students gave complete falsification solutions 33% of the time and senior citizens 15% of the time. The performance of the college students is significantly greater than chance while the performance of the senior citizens is at chance levels, (chance = 18.75%). These percentages also are significantly different.

As in experiment 1, the main anova revealed a main effect of problem. Subsequent comparisons indicated better performance for all three familiar content problems than for the abstract content ones. Again there was no difference in performance on the two

abstract content problems.

The final area for consideration is the comparison of subjects who consistently gave complete falsification solution across familiar problems. To be consistent with experiment 1, only the two more successful problems from this second experiment (Medication and I.D. Problems) were considered. That is, a consistency score indicated complete falsification solution on both of the remaining familiar problems. Expressed as the percentage of the total number of subjects at each age level, these scores are 25% for the college students and 10% for the senior citizens. These percentages are both low and were not found to differ.

In conclusion, study 1 demonstrated the stability of formal operational reasoning across the adults years and also the role of semantic content as a moderator. Study 2, however, showed the effect of semantic content, but did not support a hypothesis of late adult reasoning competence.

What then are we to make of this contradiction: When content that is meaningful and youth oriented, older adults demonstrate intact logical reasoning abilities. However when meaningful, elderly oriented content is used, the older subjects perform quite poorly. It seems to us that two alternate hypotheses must be considered. On the one hand it may be the case that old-relevant content may raise strong emotional involvement on the part of the elder adults resulting in poor performance. On the other hand the age-related content may be producing a number of exceptions that lead the older subjects not to respond formally

to the stated rule. One problem with this latter hypothesis is that from examining the data, no systematic pattern emerges that may correspond to some other thinking strategy.

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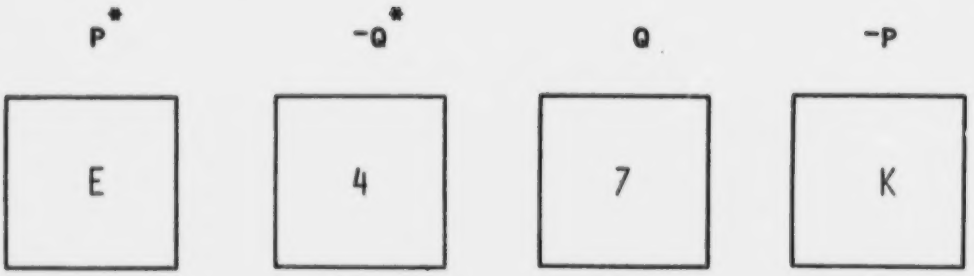
OVERTON, W. F., YAURE, R. & WARD, S. L. DEDUCTIVE REASONING IN ADULTS (1986)

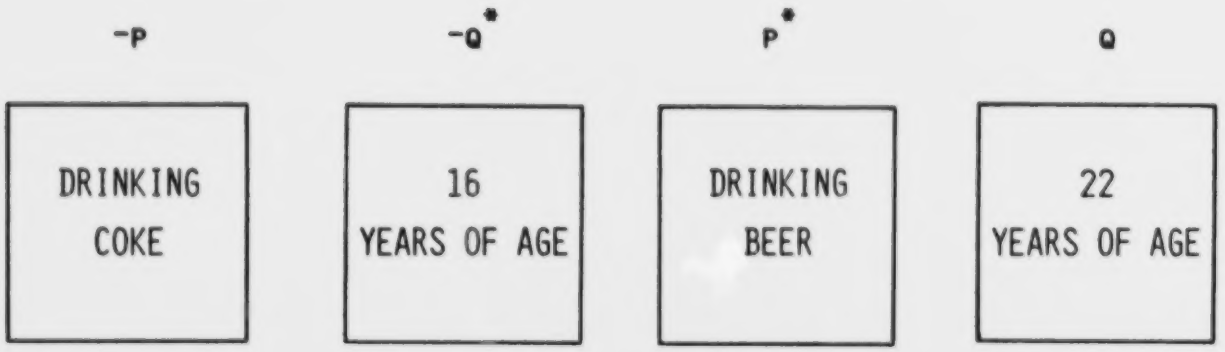
WASON'S SELECTION TASK

STANDARD ABSTRACT CONTENT



"IF A CARD HAS A VOWEL ON ONE SIDE, THEN IT HAS ODD NUMBER ON THE OTHER SIDE."

THEMATIC CONTENT



"IF A PERSON IS DRINKING BEER, THEN THE PERSON MUST BE OVER 21."

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*CORRECT SELECTIONS

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Deductive Reasoning in Young and Elderly Adults

Young-Relevant Content Problems

Drinking-Age: If a person is drinking beer, then the person must be over 21.

Motor-Vehicle: If a person is driving a motor vehicle, then the person must be over 16.

School: If a person has more than 10 absences in a school year, then the person must repeat the school year.

Old-Relevant Content Problems

Medication: If a person is taking medication, then the person must have a prescription.

I.D.: If a person is receiving a discount on public transportation, then the person must have an I.D. card.

Pension: If a person is receiving a pension, then the person must be over 65.

Abstract Content Problems

Vowel: If a card has a vowel on one side of the card, then it has an odd number on the other side.

Abstract: If a card has a D on the one side, then it has a 3 on the other side.

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